NUI Galway
OÉ Gaillimh

Semester 1 Examinations 2014/ 2015

Exam Code(s)	4BCT1
Exam(s)	4th Year Examination Computing Science and IT
Module Code(s)	CT421
Module(s)	Artificial Intelligence
Paper No.	1
Repeat Paper	No
External Examiner(s)	Professor Liam Maguire
Internal Examiner(s)	Professor G Lyons Dr. M Madden *Dr. C Mulvihill *Dr. F Smith

Instructions: Answer 2 questions from each section. All questions will be marked equally. Use a separate answer book for each section.

Duration	2 hours
No. of Pages	5
Discipline(s)	IT
Course Co-ordinator(s)	

Requirements:

MCQ	Release to Library: Yes ☐ No ☐
Handout	None
Statistical/ Log Tables	None
Cambridge Tables	None
Graph Paper	None
Log Graph Paper	None
Other Materials	None
Graphic material in colour	Yes ☐ No ☐

PTO

Section A

1
(a)
What is fuzzy logic? (5 marks)
(b)
Does absolute truth exist in fuzzy logic? Explain your answer. (5 marks)
(c)
How does fuzzy logic differ from conventional ‘crisp’ logic? (5 marks)
(d)
Describe the steps used in fuzzy rule based systems. (5 marks)
(e)
Consider the assertion “Boolean logic is just a special case of fuzzy logic”. Do you think this is true? Explain your answer. (5 marks)

PTO

2

a) Explain what is meant by Qualitative Reasoning. What are its advantages and disadvantages.
(4 marks)

b) Give an example of an application where Qualitative Reasoning would be suitable. Justify your answer.
(3 marks)

c) Give an example of an application where Qualitative Reasoning would not be suitable. Justify your answer.
(3 marks)

d) Given the following constraints (which represent the motion of a ball being thrown in the air):

DERIV(x , v)
DERIV(v , a)
a = g < 0

and the quantity spaces:
{ -∞, 0, ∞} for v
{ 0, top } for x

If the initial state is:
$QS(x,t_1)$=<top,std>
$QS(v,t_1)$=<0,dec>
$QS(a,t_1)$=<g,std>

What are the possible next states? (Show your workings)

Rule-id	$QS(v,t_i)$	$QS(v,t_i,t_{i+1})$
P1	$<l_i$,std>	$<l_i$,std>
P2	$<l_i$,std>	$<(l_i,l_{i+1})$,inc>
P3	$<l_i$,std>	$<(l_{i-1},l_i)$,dec>
P4	$<l_i$,inc>	$<(l_i,l_{i+1})$,inc>
P5	$<(l_i,l_{i+1})$,inc>	$<(l_i,l_{i+1})$,inc>
P6	$<l_i$,dec>	$<(l_{i-1},l_i)$,dec>
P7	$<(l_i,l_{i+1})$,dec>	$<(l_i,l_{i+1})$,dec>

(10 marks)

e) What discrete states would the ball pass through after being thrown up into the air?
(5 marks)

PTO

3

(a)

How does AI search differ from searches that are applied to data structures? (5 marks)

(b)

Describe Heuristic Search, paying particular attention to the advantages and disadvantages. (10 marks)

(c)

Describe depth first search with iterative deepening. Why is it such a good search technique? (10 marks)

PTO

Section B

4

(a) Give your understanding of the term ‘greedy algorithm’ (5 marks)

(b) Consider a machine that dispenses change using a greedy algorithm. If the change required is 30, and the coins available are 1,5,10, and 20, state what coins will be dispensed. If the change required is 30 and the coins available are 25, 10 and 1, state what will happen. Is this the best that could be done if the aim is to minimise the number of coins in the change? (10 marks)

(c) Consider the following graph. A and E are connected. A and F are connected. B and D are connected. B and F are connected. C and D are connected. C and E are connected. Give one ordering for the vertices where a greedy algorithm will find an optimal colouring for the graph, and one where it will not. (10 marks)

5

(a) In the context of genetic algorithms, explain what is meant by the term ‘fitness function’ (5 marks)

(b) A genetic algorithm has been developed for evolving programs for a simple stack machine with a small instruction set. The instructions include one for multiplying the top two items and placing the result on the stack (MUL), adding the top two items and placing the result on the stack(ADD), duplicating an item, swapping the top two items (i.e. A B on the stack becomes B A), and an instruction STRANGE that turns A B on the stack into B A B. Suppose that a program STRANGE ADD MUL ADD has been evolved. Further suppose that the stack contains the three items x, y, z, x on top. By considering the equation x*y + y*y +z, suggest the purpose of the instruction STRANGE. (10 marks)

(c) A student is developing a genetic algorithm for the travelling salesman problem and is considering an example that involves visiting forty cities. The student has developed a mutation operator that allows an integer such as 12 mutate into any other integer such as 24 (each such integer representing a city in the tour). Discuss one problem with this approach. (10 marks)

6

“Systems like Siri from Apple, Google Now, Cortana from Microsoft and Watson from IBM represent visions of the future for Artificial Intelligence” Discuss this statement from the perspectives of digital assistants (10 marks), game playing (10 marks) and data mining (5 marks). (25 marks)